

## ***MSPSP - Practical***



# **NASA ELV PAYLOAD SAFETY & MISSION SUCCESS CONFERENCE**


**LEARNING FROM THE PAST - ENABLING FUTURE SUCCESS**

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## **Agenda**

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- Introduction
  - Expectations
  - Administrative Recommendations
  - Safety Data
  - Ground Support Equipment
  - Variances
  - Ground Operations
  - Technical Operating Procedures
  - Contingency Operations
  - Additional Suggestions
  - Closing Thoughts

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2

# Introduction

- MSPSP - data submittal that provides a detailed description of hazardous and safety critical ground support and flight hardware equipment...used in the launch of launch vehicles and payloads.
- Pragmatic Approach
  - What we want to see...and sometimes don't.
  - What we sometimes hear...and wish we never had.
  - What's nice...and might make our jobs easier.
- Goals
  - Save work    - Save time    - Reduce stress
  - Ensure safety    - Contribute to world peace

*Note: Presentation is not to be construed as contractual direction, interpretation of requirements, or finger-pointing...just a collection of humble opinions and lessons learned to make the process easier for everyone.*

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3

# Expectations

- Accurate and complete data
  - Nothing is assumed by the reviewer
  - Data package is the only 'official' source of info
- Adherence to commitments, procedures, and schedule
- Objective evidence is desired, if not already required
  - Your credibility is at stake
- Act within your authority and capabilities
- Frequent, clear, and open communication
  - Misunderstanding is probably the source of most problems
  - Reviewers don't have the level of design insight as the payload safety organization

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4



# Administrative Recommendations



- Interim (advance) submittals
  - Identify and address issues as they arise, rather than (too) late in the process
- Formal Data submittals
  - On-time delivery of released data
    - Advance copy appreciated; a 'heads-up' that it's in the mail is valuable
    - "Officially" released data shall be approved by approving authorities before submitting
- MSPSP Revisions
  - TBDs expected only in early submittals
  - Use 'change bars' on subsequent revisions and 'change page' for revision history
  - Map all responses to reviewers comments (pg. & para. reference to data package)
  - Ensure configuration management
- Consistency in data and implementation
  - Hazard Reports, Tailored requirements, Safety Data Package, procedures, SVTL

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5

# Safety Data



- Define 'standard' terminology
  - What's considered the payload...the spacecraft/bus/platform and instruments...or just the instruments? Is the AKM part of the spacecraft or vehicle upper stage?
- Mission Description
  - Succinct summary of mission goals, with URL of project website
  - More detail if ground operations takes an atypical role
- Hazard Reports
  - Think conservatively
  - Consider all configurations, processing locations, pad activities
  - Identify pre- and post-mitigation risk; use 5 x 5 risk matrix
  - Provide access to SVTLs and timely closure
- References / Applicable Documents
  - Scrub for old revisions, superseded, and missing applicable documents

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6

## Safety Data (cont'd)



- Compliance is required to the most stringent requirement (NASA, USAF, other)
- Data typically 'forgotten' in Hazard Reports or assessments:
  - Reaction wheels
  - Heat pipes
  - Tipping hazards
  - Human Factors
  - Battery pressure vessel characteristics
  - Electrical grounding and wiring
  - Software Safety
  - Non-explosive initiator categorization
- Inhibit identification
  - Clear description; define on schematics
  - Identify inhibit status for configuration changes in a matrix
  - Conduct an integrated assessment
  - Ensure and define monitoring capabilities

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7

## Safety Data (cont'd)



- Propulsion Systems
  - Pressure Vessel Qualification and Acceptance Test Data
    - Stress Analysis
    - NDE Plans / criteria
    - Tank Log Books
    - Burst Test and failure mode, LBB vs. BBL
    - Fracture Mechanics Analysis
    - Test Certifications
    - MRB Items and disposition
  - Lines and fittings: inspection, test, safety factors
  - Integrated system: inspection, proof and leak tests
  - If qualification by similarity, ensure MPE is not exceeded

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8



## Safety Data (cont'd)



- Plastic Films, Foams and Adhesive Tapes
  - Assessment includes flight hardware, GSE, shipping materials
  - Select materials that pass safety requirements for flammability, ESD, and propellant compatibility
    - Select/submit information early
    - Utilize approved material databases: MAPTIS, KTI-5212, etc.
    - Testing at KSC is no longer gratis
  - Material Use Authorizations
    - Approved by cognizant safety POCs
    - Identify all facilities, location on flight hardware or GSE, periods of use, and operational controls

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9

## Safety Data (cont'd)



- Hazardous Materials
  - All hazardous materials to be identified with related data (matrix)
    - System/use
    - Associated Hazard (toxic, flammability, explosive...)
    - Quantity (Bulk, and application)
    - Exposure limits
    - Facilities where used
    - Hazard category
    - PPE required
  - MSDSs to be provided by payload program for use in facility
    - No need to provide in data package for common materials ( $N_2H_4$ , IPA,  $N_2$ , etc.)

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10

# Ground Support Equipment



- Electrical Ground Support Equipment (EGSE)
  - Commercial off-the-shelf (COTS) EGSE
    - UL/NEC/NFPA approved or compliant
    - Define modifications & deviations from manufacturer's intended use
  - Internally designed
    - Designed to NEC / NFPA
    - Designed to NASA, AF and/or other consensus standards

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11

## Ground Support Equipment (cont'd)



- Electrical Ground Support Equipment (EGSE) (cont'd)
  - Hazard-proofed or explosion-proof for hazardous environments
  - Tip-over analysis
  - Electrical Schematic and block diagram of integration with other hardware
  - Approved ordnance test equipment
  - Battery charging EGSE
    - Parameters monitored / set-points
    - Technician interface

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12



## Ground Support Equipment (cont'd)



- Mechanical Ground Support Equipment
  - Lifting devices and Equipment
    - Proof-tested, tagged, and configuration controlled
    - Single point failures identified
      - NDE Plan and criteria
    - Assessment of flight hardware lifting points
    - Tip-over analysis
      - Lifting configuration cg
      - Spacecraft static; seismic requirements
    - Locking wheels and load capacity
    - Requirements are applicable to leased equipment
    - Operations under a suspended load are not permitted

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13

## Safety Variances



- Advise your NASA PSWG representative(s) as soon as a potential noncompliance is identified
  - Assistance with the interpretation of requirements
  - Determination of mitigations and/or alternative strategies
- Provide a DRAFT Variance before obtaining signatures
  - Changes may be required
  - Approval process sometimes differ with risk or facility
  - Avoids re-staffing
- Cost or schedule is not an acceptable rationale
- Different organizations use different terminology
- Use required format for variance; provide analyses

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14

# Ground Operations



- Approval of flight hardware and ground safety data is required prior to ship/operations
- Safety representative should support facility walkdown
- Observe facility requirements and include in plans and operations
  - Life Safety Code
  - Manloading requirements
- Observe your operational plans/policies
  - Hurricane, Lightning
  - Maximum work time
  - Tool control, and tethering
- Project safety representative should be present during hazardous operations
  - Activities shall be identified in Systems Safety Program Plan
  - Experienced with hardware, facility, and operations
- Report close calls and mishaps
  - NASA Policy and contractual requirements

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15

# Technical Operating Procedures



- All procedures are to be summarized in the safety data package
  - Procedures to be categorized as 'hazardous' or 'non-hazardous'
    - Rationale for any 'non-hazardous' classification is required
    - Hazardous procedures must be approved before use
      - Submit only 'released' procedures for approval
      - Provide transmittal memo to identify POCs and need date
      - Typically submitted 55 days prior to need date
      - Must be approved and 'on-the-shelf' 10 days before use
  - Provide a sample (draft) procedure for format approval
  - Prioritize and provide released procedures as they are available
  - If redlines are necessary, provide ASAP, not at pre-task brief

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16



# Contingency Operations



- Ionizing and Non-ionizing (including Lasers)
  - Submit Use Request and Training Forms early
  - Reference in data packages and procedures (with submittal date), anticipating approval
  - Clearly / completely identify where, when, and what device will be operational
  - Identify operating location(s) and storage of radioactive source
  - Define radioactive sources as flight hardware or calibration (GSE)
  - Anticipate contingencies, and include when preparing Use Requests

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17

# Contingency Operations (cont'd)



- Propellant Offload
  - Ability to offload is required at the processing facility and Pad
  - Ensure accessibility of service valves through fairing doors
  - Coordinate Plans and Procedures
    - Contingency Offload Plan by launch vehicle contractor
      - Defines responsibilities, response limitations, GSE staging, vehicle support and preparation
    - Contingency Offload Procedures by spacecraft
      - Detailed procedure identifying steps for depressurizing and offloading propellant
  - Demonstrate feasibility of procedures
    - Consider required tools, fairing door size, reach, SCAPE limitations, work platforms, etc.
    - Offload exercise with operators in PPE, or CAD / high fidelity mock-up
  - Plans and procedures to be approved prior to fueling/transport
  - *“Expect the worst...you’ll never be disappointed.”*

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18

## Additional Suggestions

- Mentor and continually train
- Provide consistent representation in safety working group meetings
- Review and implement lessons-learned
- Follow the safety review process
  - Many safety organizations have unique contributions and authority
  - Coordinate issues with NASA POCs before going external

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19

## We're always here to help...



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20



# Closing Thoughts



- Keep up the great job!
- Little things sometimes make a big difference
- Continuous improvement
  - NASA ELV Payload Safety Program
- *“God, give me patience....AND I WANT IT NOW!”*

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21